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Production of Scallop Seed

Spawning Induction

T. Tanaka, A. Sato, K. Kawamura

In induced spawning by scallops, as in the case of other P.28 bi-valve shellfish, a heating stimulus has been used which gradually raises the temperatures of seawater poured over scallops contained in a tank. However, because there were few scallops that responded when this method was carried out last year, an ultraviolet lamp was used this year in addition to the traditional heating stimulus. It is reported here that this new method is effective in inducing spawning by scallops, as it has been reported to be effective for induced spawning in the abalone family.

MATERIALS AND METHOD

The scallops used in the induction experiments were 2 and 3 years old scallops reared through suspended culture (spawned in 1971 and in 1972 respectively), and 4 and 3 years old scallops reared through seabed-culture (spawned in 1970 and in 1971 respectively) which were collected from eight locations in the Mutsu Bay between December 21, 1973 and

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April 1, 1974. As standard of maturity of their gonads, a gonad index ($\frac{\text{weight of gonads}}{\text{Body weight}} \times 100\%$) was calculated by determining the weight of the gonads at the time the scallops were collected.

Firstly, in order to examine the effectiveness of an ultra violet lamp in inducing spawning, three experiments were conducted between March 20, 1973 and April 1, 1974. To serve as control against this ultra-violet lamp irradiated seawater method, the rate of induction by heat stimulus only and the time taken by each scallop to respond to induction were studied.

The frequency of scallop spawning and spermatizing was examined in 77 scallops which responded to induction carried out by the combination of the two methods of stimuli (ultra-violet lamp & heated sea water). (The maturity of their gonads and the water temperature at the time of induction were both disregarded).

The induction rate of the scallops collected from the same place at the same time and presumed to be at the same stage of maturity (3 years old scallops from suspended culture in Yokohama-cho), was studied at different water temperatures, the lowest temperature being that of the culturing site.

The relation between the induction temperatures (when an ultra-violet lamp was also used), response time to induction, water temperature at the time of induction, gonad index and induction rate was studied in male and female scallops according to gonad index.

In these experiments, the water temperature at the time of induction was made constant.

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RESULTS AND COMMENTS

Changes in the gonad indexes according to location and time were studied by determining the weight of the gonads of the scallops from each location in the Bay for a total of 29 times. Fig. 1 indicates the frequency of changes in gonad indexes of scallops from locations off Okunai in Aomori city, Yokohama-cho, and Ohminato in Mutsu city. The gonad indexes of the scallops from each location in the Bay which were measured in this experiment are not necessarily the representative figures for the locations the scallops come from because of the differences in their background and culturing methods. However, the peak value of gonad indexes of the 3 years old scallops reared through suspended culture at each location was examined. At Okunai in Aomori city, G.I.=23.5±8.3% (38.3 - 25.6%) (measured on February 25, 1974). At Yokohama-cho, samples were collected three times between March 13th and 27th; one group of these collected samples was suspended from a raft in front of the Laboratory and P.29 measurements were taken at a later time. A total of four measurements were taken. The average values (range) of the gonad indexes of each sample collection were: 25.9±5.2% (42.1 - 18.0%) (measured on March 13, 1974), 28.2±7.5% (35.4 - 23.1%) (March 20, 1974), 32.0±3.8% (33.8 - 28.6%) (March 27, 1974), 30.0±3.8% (39.6 - 21.6%) (March 27, 1974).

The scallops from Ohminato in Mutsu city were measured three times, March 7th, 13th and 27th. The range of gonad index at these

measurements were: 41.3 - 17.3% (March 7, 1974), 40.6 - 17.8% (March 13, 1974), and 41.7 - 28.3% (March 27, 1974), which is fairly high. The average values of gonad index were 23.5±4.8%, 26.0±5.0%, and 33.1±3.7% respectively, indicating a high value toward the end of March. Gonad indexes were higher at Yokohama-cho and at Ohminato in Mutsu city in the East Bay than at Okunai in Aomori city in the West Bay. The period of highest gonad index was reached earliest at Okunai in Aomori city, then at Yokohama-cho and finally at Ohminato in Mutsu city.

Fig. 2 shows the induction effect of seawater which was passed through a ultra-violet light. No.1 represents 3 years old scallops reared through suspended culture in Yokohama-cho whose G.I. (female)=30.8±3.3% and G.I. (male)=28.1±3.2%. No.2 represents 4 years old scallops sea bed-cultured in Oura with G.I. (female)=15.3±2.1%, G.I. (male)=15.4±2.8%. No.3 represents 3 years old scallops from the same site with G.I. (female)=10.1±2.2% and G.I. (male)=12.3±2.2%. As indicated in Fig. 2, the females responded 100% to induction in each case in the No.1 group. The males responded 100% when an ultra violet lamp was used and 50% without it. The ultra violet lamp was found to have a favourable effect on induction rate and time required for induction.

As indicated in No.2 and No.3, the sea bed-cultured scallops from Oura responded to spawning induction with a fairly lower gonad index than had been traditionally believed. Though this fact may well suggest the effectiveness of the induction method, it seems that the sea bed-cultured scallops have different spawning conditions from the scallops reared through suspended culture. P.30

Regarding the 77 scallops which responded to spawning induction in this experiment, the hours at which they responded to induction are shown in Fig. 3. Although there seems to be a certain time period for the commencement of spawning-spermatizing, this pattern of spawning activity seems to be due to the starting time of induction. Therefore, no generalization can be made that this is the time period when scallops are most likely to spawn. No conclusions can be drawn about this subject unless the starting time of spawning is studied by using scallops with the same background and by varying the induction time. Though no comparison can be made by gonad index or by water temperature at the time of induction, only 5 scallops among the 77 that spawned or spermatized took longer than 5 hours to respond to induction. Consequently, the pattern for the start of spawning was within 2 - 3 hours of induction.

In order to study the time required for male and female scallops to respond to induction, 5 each of 3 years old males and females reared through suspended culture in Yokohama-cho and collected on March 27th (G.I. female = 29.6±4.3%, G.I. male = 30.6±3.0%), were placed individually in a tank and tested for induced spawning. The result is shown in Fig. 4. As indicated in Fig. 4, spawning could not be induced even with the use of a ultra-violet lamp at the water temperature of either 5.4°C or 7.4°C. Both males and females responded 40% and 20% respectively when the water was heated to 8.9°C and the ultraviolet lamp was used. At 11.8°C, the females responded 100% but the response from the males was 20%. Since the females responded 100% at 11.8°C, only the males were tested at 13.2°C and 14°C. The resulting induction rates were 40% and 100% respectively. In the case of scallops with the same background,

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induction was unsuccessful even with the ultraviolet lamp at the water temperature of the culturing site. It was found, however, that spawning induction was accelerated by heating the se ater. P.31

In order to show the relation between the time required for spawning (spermatizing) and the water temperature at the time of induction, gestation indexes are divided into three levels in Fig. 5, i.e. 10-20%, 20-30%, and over 30%. The scallops which responded to induction are separated by gonad index and by sex in Fig. 5. As shown in Fig. 5, the value of gonad index has no relation to induction. Of the 77 scallops which responded to induction in this experiment, 9.1% responded within one hour, 24.7% within 1-2 hours, 35.0% within 2-3 hours, 15.5% within 3-4 hours, 10.4% within 4-5 hours and 5.7% after 5 hours, as indicated in Fig. 3.

Figs. 6 and 7 show the relation between gonad index, water temperature and induction rate.

21 groups were separated by gonad index and water temperature. The gonad indexes and the water temperatures at the time of induction of these 21 groups were known exactly. For convenience, the gonad indexes were divided into three levels, 10-20%, 20-30%, and over 30%; water temperature was divided into four levels, under 6°C, 6-10°C, 10-15°C, and over 15°C. When looking at the relation between water temperature and induction rate in each level of gonad index, it is found that spawning was not induced, regardless of the value of gonad index, with the water temperature at the culturing site. Some scallops started to respond to spawning induction at 13.4°C in 10-20% level, at 9.8°C in 20-30% level and at 8.9°C in over 30% level. It was found that the higher the gonad index, the lower the water temperature when scallops responded to induction.

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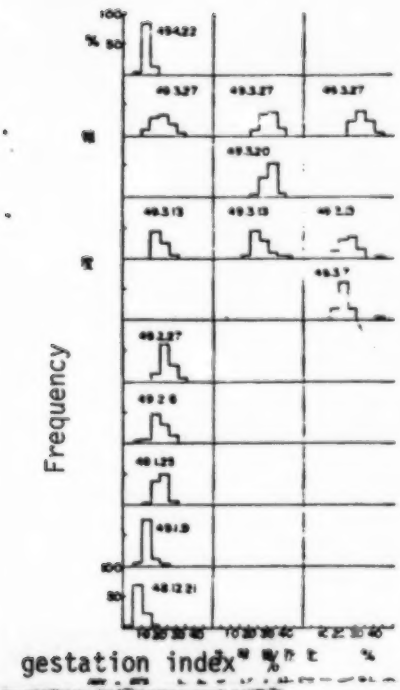


Fig. 1.
Changes in Gonad Index of Scallops by Location and Time
(note)
Suspended-culture 3 years old scallops: from left to right, Okunai in Aomori city, Yokohama-cho, Ohminato in Mutsu city
The figures in the chart represent dates of measurements.
49=1974

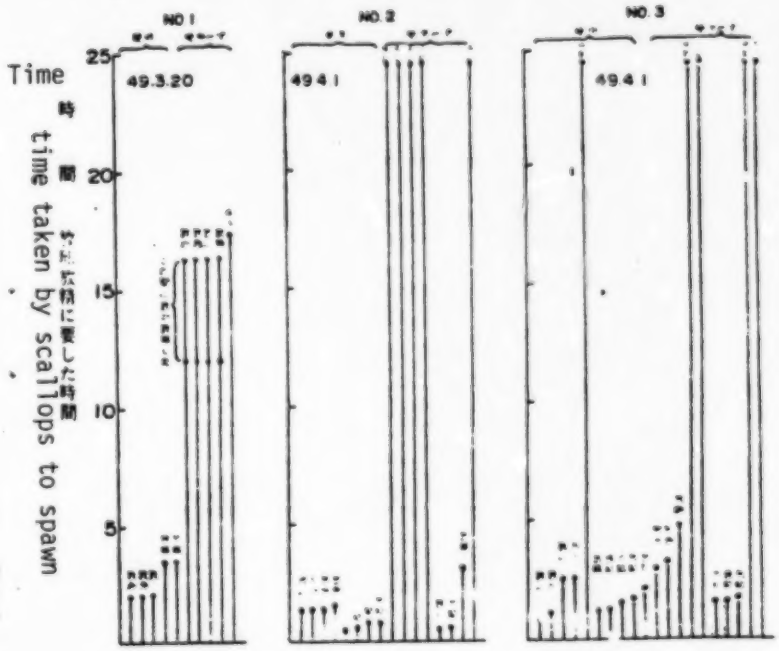


Fig. 2 Effect of ultraviolet lamp in spawn induction
No.1: 3 years old scallops from suspended culture in Yokohama-cho
No.2: scallops sea bed-culture in Oura
No.3: scallops " "
" "

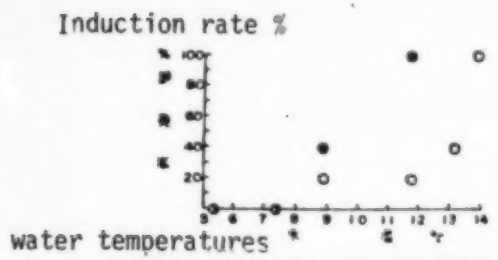
● females
○ males

第3図 ホタテガイの誘発開始時刻と放卵、放精時刻
誘発開始時刻 放卵、放精時刻

Fig. 3 Starting time of induction and spawning · spermatizing time of scallops.

Starting time of induction

Spawning · spermatizing time



第4図 ホタテガイの誘発水温と誘発率
● 雌 ○ 雄

Fig. 4 Induction temperatures and induction rate

● female
○ male

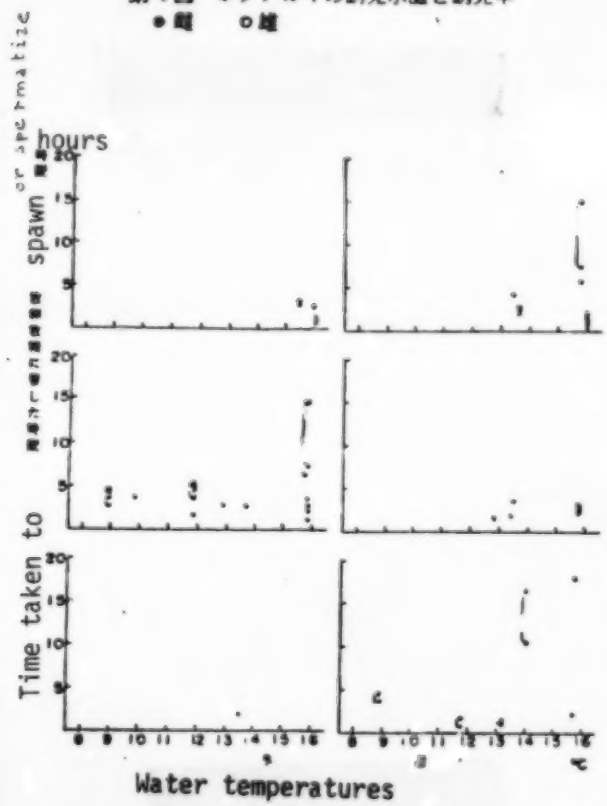


Fig. 5 Induction temperatures and time required for spawning · spermatizing

Left column: Female
Right column: Male

: time when spawning · spermatizing occured

Range of G.I. from top to bottom:
10-20%, 20-30%, over 30%

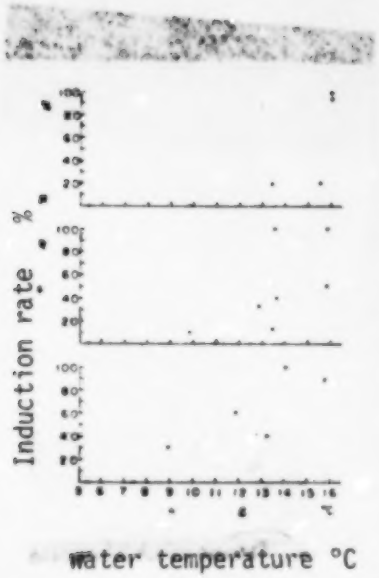


Fig. 6 The relation between induction temperature and induction rate

Range of gonad index from top to bottom: 10-20%, 20-30% over 30%

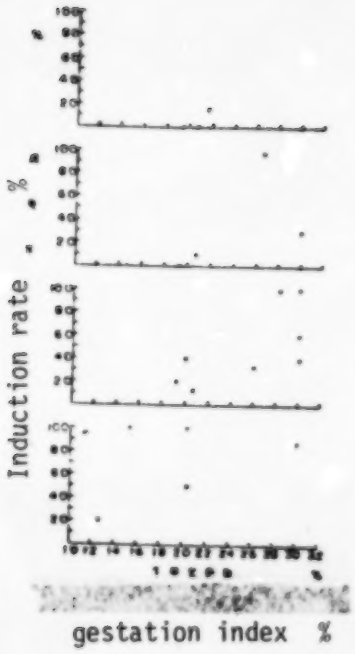


Fig. 7 The relation between gonad index and induction rate

Range of water temperatures from top to bottom: under 6°C, 6-10°C 10-15°C over 15°C